

CLAIMS

What is claimed is:

1. A method of adaptively writing magnetic memory cells of a magnetic random
5 access memory (MRAM), the method comprising:
providing a logical data block of a memory array having magnetic memory cells, each
magnetic memory cell in a known initial state and each magnetic memory cell
configured along an easy-axis magnetic field generating conductor;
writing to the magnetic memory cells using a predefined minimum current level;
10 sensing the magnetic memory cells to determine if data has been successfully written; and
incrementing the current level if writing was unsuccessful and repeating the steps of writing
to the magnetic memory and sensing the magnetic memory.
2. The method according to claim 1, further comprising recording current level
15 for future writing if writing was successful.
3. The method according to claim 1, wherein providing the logical data block
comprises providing a logical data block having more magnetic memory cells configured
along the easy-axis magnetic field generating conductor than along hard-axis conductors.
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4. The method according to claim 1, wherein providing the logical data block of
the memory array having the magnetic memory cells, each magnetic memory cell in a known
initial state, comprises writing the known initial state into each of the plurality of magnetic
memory cells in the logical data block using only easy-axis write current.
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5. The method according to claim 4, wherein the known initial state comprises a
logical one state.
6. The method according to claim 1, wherein writing to the magnetic memory
30 cells using the predefined minimum current level comprises:
applying a fixed write current to the easy-axis magnetic field generating conductor;
applying the predefined minimum current level to hard-axis magnetic field generating
conductors; and

configuring intersections of the easy-axis magnetic field generating conductor and the hard-axis magnetic field generating conductors as the magnetic memory cells.

7. The method according to claim 1, wherein sensing the magnetic memory cells
5 to determine if data has been successfully written comprises:
comparing states of the magnetic memory cells to the known initial state;
determining if the states of the magnetic memory cells are opposite the known initial state,
wherein the data has been successfully written; or
determining if the states of the magnetic memory cells are the same as the known initial state,
10 wherein the data has not been successfully written.

8. A method of determining a write current threshold for writing magnetic
memory cells of a logical data block of a magnetic random access memory (MRAM), the
method comprising:
15 providing a logical data block of a memory array having a plurality of magnetic memory
cells, each magnetic memory cell in a known initial state and each magnetic memory
cell oriented along an easy-axis magnetic field generating conductor;
setting a write current level to a first value;
applying the write current level at the first value to a selected magnetic memory cell in the
20 memory array;
sensing a state of the selected magnetic memory cell;
incrementing the write current level from the first value to a second value higher than the first
value; and
repeating the step of applying the write current level if the state of the selected magnetic
25 memory cell remains in the known initial state.

9. The method according to claim 8, further comprising addressing another
magnetic memory cell in the memory array as the selected magnetic memory cell and
repeating the method according to claim 8.

30 10. The method according to claim 9, further comprising storing a final value as a
write current threshold for future writing if there are no remaining magnetic memory cells.

11. The method according to claim 8, wherein applying the write current level to a selected magnetic memory cell in the memory array comprises:

applying a fixed write current to the easy-axis magnetic field generating conductor;

applying the write current level to a hard-axis magnetic field generating conductor; and

5 configuring an intersection of the easy-axis magnetic field generating conductor and the hard-axis magnetic field generating conductor as the selected magnetic memory cell.

12. A method of writing magnetic memory cells of a magnetic random access memory (MRAM), the method comprising:

10 determining a write current threshold for writing the magnetic memory cells of the MRAM;

addressing selected magnetic memory cells of the MRAM; and

writing the selected magnetic memory cells using the write current threshold.

13. The method according to claim 12, wherein determining a write current
15 threshold, comprises:

providing a logical data block of a memory array having a plurality of magnetic memory cells, each magnetic memory cell in a known initial state and each magnetic memory cell configured along an easy-axis magnetic field generating conductor;

setting a write current level to a predetermined minimum;

20 applying the write current level to a selected magnetic memory cell in the memory array;

sensing a state of the selected magnetic memory cell;

incrementing the write current level and repeating above if the state of the selected magnetic memory cell remains in the known initial state; or

addressing the next magnetic memory cell in the memory array as the selected magnetic

25 memory cell and repeating above.

14. A method for writing magnetic memory cells of a magnetic random access memory (MRAM), the method comprising:

providing a plurality of logical data blocks in a memory array, each logical data block having
30 magnetic memory cells configured along an easy-axis magnetic field generating conductor;

writing all memory cells to a logical one state;

for each of the plurality of logical data blocks:

- (a) writing selected memory cells to a logical zero state using a write current threshold initially set at a predefined minimum level on a hard-axis magnetic field generating conductor;
- (b) sensing the selected memory cells;
- 5 (c) incrementing the write current threshold if any of the selected memory cells failed to change to the logical zero state; and
- (d) repeating (a) through (c) above until all of the selected memory cells change to the logical zero state.

10 15. The method of claim 14, wherein writing all memory cells to a logical one state comprises writing the logical one state using only easy-axis write current.

16. The method of claim 14, wherein providing the plurality of logical data blocks comprises providing a plurality of logical data blocks each having a size selected according to
15 a preselected, block-based error correction code.

17. The method of claim 16, wherein the preselected, block-based error correction code comprises Bose-Chaudhuri-Hochquenghem (BCH) code.

20 18. The method of claim 16, wherein the preselected, block-based error correction code comprises Reed-Solomon code.

19. The method of claim 16, wherein the preselected, block-based error correction code comprises run length limited (RLL) code.
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